CLAIMS

The invention claimed is:

1. A phase shifter, comprising:

a backplane carrying a transmission media trace;

a wiper arm pivotally attached to the backplane and carrying a trace contact;

an actuator for pivoting the wiper arm with respect to the backplane;

a signal conductor in electrical communication with the trace contact; and

a cantilever shoe including a trace contact biasing element configured to bias the trace contact toward the transmission media trace.

2. The phase shifter of claim 1, wherein the trace contact biasing element comprises a spring-loaded plunger positioned adjacent to the trace contact.

3. The phase shifter of claim 1, wherein:

the signal conductor comprises a signal trace carried on the backplane;

the wiper arm comprises a signal contact electrically located between the signal conductor and the trace contact; and

the cantilever shoe comprises a signal contact biasing element configured to bias the signal contact toward the signal trace.

4. The phase shifter of claim 1, wherein the signal contact biasing element comprises a spring washer positioned adjacent to the signal contact.

5. The phase shifter of claim 1, wherein the actuator comprises a knob for manually pivoting the wiper arm.

6. The phase shifter of claim 1, wherein the actuator comprises a motor for mechanically pivoting the wiper arm.

7. The phase shifter of claim 6, wherein the wiper arm is located on a front side of the backplane and the motor is located on a rear side of the backplane.

8. The phase shifter of claim 6, further comprising a controller for remotely controlling the motor.

9. The phase shifter of claim 1, wherein the wiper arm defines a gear section.

10. The phase shifter of claim 9, in combination with a second similar phase shifter, wherein the gear sections of the wiper arms engage each other to cause coordinated pivotal movement of the wiper arms.

11. The phase shifter of claim 10, wherein each phase shifter drives a polarization circuit of a dual-polarization antenna.

12. An antenna system, comprising:

an array of antenna elements;

a phase shifter including a backplane carrying a transmission media trace, a wiper arm pivotally attached to the backplane and carrying a trace contact, an actuator for pivoting the wiper arm with respect to the backplane, a signal conductor in electrical communication with the trace contact, and a cantilever shoe comprising a trace contact biasing element configured to bias the trace contact toward the transmission media trace;

a beam forming network in electrical communication with the phase shifter and producing a plurality of beam driving signals;

a signal distribution network delivering each beam driving signal to one or more associated antenna elements; and

the beam driving signals driving the antenna elements to form a beam exhibiting a direction that varies in response to pivotal movement of the wiper arm.

13. The antenna system of claim 12, wherein the phase shifter drives a variable power divider electrically located between the phase shifter and the beam forming network to produce complimentary amplitude voltage drive signals over a range of voltage amplitude division.

14. The antenna system of claim 12, wherein the actuator comprises a motor for mechanically pivoting the wiper arm.

15. The antenna system of claim 14, further comprising a controller for remotely controlling the motor.

16. The antenna system of claim 12, wherein:

each antenna element is a dual-polarization antenna element, further comprising a similar phase shifter, beam forming network, and signal distribution network for each polarization;

each wiper arm defines a gear section; and

the gear sections of the wiper arms engage each other to cause coordinated pivotal movement of the wiper arms.

17. The antenna system of claim 16, wherein the actuator comprises a motor for mechanically pivoting the wiper arm.

18. The antenna system of claim 17, further comprising a controller for remotely controlling the motor.

19. The antenna system of claim 18, wherein the wiper arms are located on a front side of the backplane and the motor is located on a rear side of the backplane.

20. A antenna system comprising:

an array of antenna elements;

a phase shifter including a backplane carrying a transmission media trace, a wiper arm pivotally attached to the backplane and carrying a trace contact, an actuator for pivoting the wiper arm with respect to the backplane, a signal conductor in electrical communication with the trace contact, and a hold-down mechanism comprising a trace contact biasing element configured to bias the trace contact toward the transmission media trace;

a variable power divider in electrical communication with the phase shifter and producing complimentary amplitude voltage drive signals over a range of voltage amplitude division;

a beam forming network receiving the voltage drive signals and producing a plurality of beam driving signals;

a signal distribution network delivering each beam driving signal to one or more associated antenna elements; and

the beam driving signals driving the antenna elements to form a beam exhibiting a directional tilt with respect to the boresight direction that varies within a range of tilt in response to changes of the voltage amplitude division within the range of voltage amplitude division.

21. The antenna system of claim 20, wherein:

each antenna element is a dual-polarization antenna element, further comprising a similar phase shifter, variable power divider, beam forming network, and signal distribution network for each polarization;

each wiper arm defines a gear section; and

the gear sections of the wiper arms engage each other to cause coordinated pivotal movement of the wiper arms.

22. The antenna system of claim 20, wherein the wiper arm is located on a front side of the backplane, further comprising a motor located on a rear side of the backplane for mechanically pivoting the wiper arm.

23. The antenna system of claim 20, wherein the hold-down mechanism comprises a cantilever shoe that biases the trace contact towards the transmission media trace without relying on an element that passes through the backplane adjacent to the trace contact.

24. An antenna system comprising a phase shifter having a wiper arm in sliding electrical communication with a microstrip trace located on a backplane and a cantilever shoe configured to bias the wiper arm toward the microstrip trace.

25. An antenna system comprising a phase shifter having a wiper arm in sliding electrical communication with a microstrip trace located on a backplane and a hold-down shoe configured to bias the wiper arm toward the microstrip trace without coupling to an element that passes through the backplane adjacent to the trace contact.

26. A dual-polarization antenna comprising a phase shifter for each polarization, each phase shifter having a wiper arm in sliding electrical communication with an associated microstrip trace, and the wiper arms defining gear portions engaging each other and causing the wiper arms to move in a coordinated manner.

27. The dual-polarization antenna of claim 26, wherein the wiper arms are located on a front side of a backplane carrying the microstrip trace, further comprising a motor located on the rear side of the backplane for mechanically pivoting the wiper arms.

28. The dual-polarization antenna of claim 26, further comprising a cantilever shoe for each wiper arm biasing the wiper arm toward its associate microstrip trace.